MONTANA STANDARDS FOR SCIENCE

Science is an inquiry process used to investigate natural phenomena, resulting in the formation of theories verified by directed observations. Inquiry challenges students to solve problems by observing and collecting data and constructing inferences from those data. In doing so, students acquire knowledge and develop a rich understanding of concepts, principles, models, and theories. (National Science Education Standards, 2004, p.214) Inquiry requires the use of scientific thinking skills to address open-ended problems through non-prescriptive procedures and allows students to construct their own knowledge of the specific concepts. This validates different ways of gathering, synthesizing and communicating knowledge. Scientific theories are challengeable and changeable. Data used to support or contradict them must be reproducible. "A goal of science education…is to help students recognize the difference between personal opinion and knowledge gained through scientific investigation and debate." (NAEP, 2005, p.8)

"Inquiry is a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results. Inquiry requires identification of assumptions, use of critical and logical thinking, and consideration of alternative explanations. Students will engage in selected aspects of inquiry as they learn the scientific way of knowing the natural world, but they also should develop the capacity to conduct complete inquiries." (National Science Education Standards, 2004, p.23)

In science, problems are identified, pertinent data gathered, hypotheses formulated, investigations performed, results interpreted, and conclusions drawn. The processes of science are constant, however science as a body of knowledge is ever changing.

Science education strengthens students' investigative skills and fosters their understanding of the world. Students acquire and apply critical thinking and problem-solving skills necessary to participate as citizens in a dynamic, global technological society. Thinking skills for example, observing, measuring, classifying, predicting, deducing, and inferring are given meaning by the context of the subject matter being studied. (NAEP, 2005, p.8)

The unifying concepts and processes of science provide connections between and among traditional scientific disciplines. The unifying concepts and processes woven into the Montana Standards for Science include: systems, order, and organization; evidence, models and explanation; constancy, change, and measurement; evolution and equilibrium; and form and function. These concepts and processes must be experienced in a developmentally appropriate manner during K-12 science education.

The implementation of these standards must incorporate the distinct and unique cultural heritage of Montana American Indians. In a broader view, culturally relevant teaching helps science come alive for all students because it includes indigenous science knowledge and indigenous world views. Culturally relevant teaching is contextually competent when it relates science to local and regional communities using individual, institutional and natural resources of those communities, cultures and societies.

Content Standards indicate what all students should know, understand and be able to do in a specific content area.
Benchmarks define our expectations for students' knowledge, skills, and abilities along a developmental continuum in each content area. That continuum is focused at three points—the end of grade 4, the end of grade 8 and grade 12.

Content Standard 1—Students design, conduct, evaluate, and communicate processes and results of scientific investigations, and demonstrate thinking skills associated with this procedural knowledge.

Content Standard 2—Students demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems, and demonstrate thinking skills associated with this knowledge.

Content Standard 3—Students demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment, and demonstrate thinking skills associated with this knowledge.

Content Standard 4—Students demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space, and demonstrate thinking skills associated with this knowledge.

Content Standard 5—Students understand how scientific knowledge and technological developments impact communities, cultures and societies.

Content Standard 6—Students understand historical developments in science and technology.

Science Content Standard 1

Students design, conduct, evaluate, and communicate processes and results of scientific investigations, and demonstrate thinking skills associated with this procedural knowledge.

Rationale

Students must understand the process of science—how information is gathered, evaluated and communicated to others. Learning by inquiry mirrors the process of science itself. The knowledge and skills related to scientific inquiry enable students to understand how science works. Inquiry allows students to construct understanding of scientific facts, principles, concepts and applications. In addition, scientific inquiry stimulates student interest, motivation and creativity.

Safety is a fundamental concern in all experimental science. Appropriate safety procedures must be applied when storing, using, and caring for materials.

All science content standards need to incorporate this process of scientific inquiry.

Benchmarks

Students will:

End of Grade 4	End of Grade 8	Upon Graduation—End of Grade 12
1. plan and safely conduct scientific investigations when given a question, identified variables, and a testable hypothesis.	1. identify a question, determine relevant variables, formulate a testable hypothesis, plan and predict the outcome of an investigation, safely conduct scientific investigation, and compare and analyze data.	1. generate a question, identify dependent and independent variables, formulate testable, multiple hypotheses, plan an investigation, predict its outcome, safely conduct the scientific investigations, and collect and analyze data.
2. select and accurately use appropriate tools including technology to make measurements (in metric units) and represent results of basic scientific investigations.	2. select and accurately use appropriate tools including technology to make measurements (in metric units), gather, process and analyze data from scientific investigations.	2. select and accurately use appropriate tools including technology to make measurements (in metric units), gather, process and analyze data from scientific investigations using appropriate mathematical analysis, error analysis, and graphical representation.
3. describe and communicate the results of scientific investigations.	3. critically review, communicate and defend results of investigations.	3. critically review evidence, communicate and defend results, and recognize that the results of a scientific investigation are always open to revision by further investigations.
4. use models that illustrate simple concepts and compare those models to the actual phenomenon.	4. create models to illustrate scientific concepts and use the model to predict change. (e.g., computer simulation, stream table, graphic representation)	4. compare observations of the real world to a mental model resulting from hypothetical, unobservable entities. (e.g., atom, expanding universe)
5. identify a valid test in an investigation.	5. identify strengths and weakness in an investigation design.	5. identify strengths, weaknesses, and assess the validity of the experimental design of an investigation through analysis and evaluation.

Science Content Standard 2

Students demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems, and demonstrate thinking skills associated with this knowledge.

Rationale

Matter exists in a variety of forms. All physical interactions involve changes in energy. Therefore, knowledge of matter and energy is essential to interpreting, explaining, predicting, and influencing change in our world.

Benchmarks

Students will:

End of Grade 4	End of Grade 8	Upon. Graduation—End of Grade 12
1. create mixtures and separate them based on different physical properties. (e.g., salt and sand, iron filings and soil, oil and water)	1. classify, describe, and manipulate physical models of matter in terms of: elements, and compounds, pure substances and mixtures, atoms, and molecules.	1. describe experimental evidence that matter consists of molecules in motion and explain physical interactions of matter using conceptual models. (e.g., the conservation of matter, kinetic molecular theory)
2. examine, describe, compare and classify objects in terms of common physical properties.	2. examine, describe, compare and classify objects and substances based on common physical properties and simple chemical properties.	2. explain the states of matter using a conceptual model consistent with kinetic molecular theory and intermolecular forces. (e.g., transition from solids to liquids to gases)
3. identify the basic characteristics of light, heat, motion, magnetism, electricity and sound.	3. describe energy and compare and contrast the characteristics of light, heat, motion, magnetism, electricity, sound and mechanical waves.	3. recognize that energy is conserved and can be changed into different forms within a variety of practical and technological applications.
4. identify that matter and energy can change from one state to another, and identify and predict what changes and what remains unchanged when matter experiences an external force or energy change.	4. model and explain the states of matter are dependent upon the quantity of energy present in the system and describe what will change and what will remain unchanged at the particulate level when matter experiences an external force or energy change.	4. identify, measure, calculate, and analyze quantitative and qualitative relationships associated with matter and energy transfer or transformations, and the associated conservation laws using words, symbolic equations, and particulate representations.
5. identify, build, and describe mechanical systems. (e.g., identify the forces acting within those systems)	5. identify, build, describe, measure, and analyze mechanical systems (e.g., simple and complex machines) and describe the forces acting within those systems.	5. recognize and describe how forces interact with matter. (e.g., gravitation, electromagnetic, laws of motion)
6. utilize classification schemes to order objects.	6. analyze data in simple scientific contexts. (e.g., density)	6. utilize thinking skills in multiple scientific contexts of increasing complexity. (e.g., mass $\propto$ moles $\propto$ number of particles)

Science Content Standard 3

Students demonstrate knowledge of characteristics, structures and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment, and demonstrate thinking skills associated with this knowledge.

Rationale

Students gain a better understanding of the world around them if they study a variety of organisms, microscopic as well as macroscopic. Through the study of similarities and differences of organisms, students learn the importance of classification and the diversity of living organisms. The understanding of diversity helps students understand biological evolution and life's natural processes (e.g., cycles, growth, and reproduction). Structure, function, body organization, growth and development, health and disease are important aspects to the study of life. The study of living systems provides students important information about how humans critically impact Earth's biomes.

Benchmarks

Students will:

End of Grade 4	End of Grade 8	Upon Graduation—End of Grade 12
1. identify that plants and animals have structures and systems, which serve different functions.	1. compare the structure and function of prokaryotic cells (bacteria) and eukaryotic cells (plant, animal, etc.).	1 investigate and use appropriate technology to demonstrate that cells have common features as well as differences that determine function and that they are composed of common building blocks (e.g., proteins, carbohydrates, nucleic acids, lipids).
2. identify and describe basic requirements of energy needed and nutritional needs for each human body system.	2. explain how organisms and systems of organisms obtain and use energy resources to maintain stable conditions (e.g., photosynthesis, respiration).	2. describe and explain the complex processes involved in energy use in cell maintenance, growth, repair and development.
3. describe models that trace the life cycles of different plants and animals and discuss how they differ from species to species.	3. communicate the differences in the reproductive processes of a variety of plants and animals using the principles of genetic modeling (e.g., Punnet squares).	3. model the structure of DNA and protein synthesis, discuss the molecular basis of heredity, and explain how it contributes to the diversity of life.
4. explain cause and effect relationships between nonliving and living components within ecosystems; and explain individual response to the changes in the environment.	4. investigate and explain the interdependent nature of both the individuals and species in the environment and explain how they are affected by human interaction.	4. predict and model the interaction of biotic and abiotic factors, which affect populations (natural selection) that contribute to the change in a species over time (evolution).
5. create and use a classification system to group a variety of plants and animals according to their similarities and differences, preferably using indigenous plants and animals.	5. create and use a basic classification scheme to identify plants and animals, preferably using indigenous plants and animals.	5. recognize, generate and apply biological classification schemes to infer and discuss the degree of divergence using ecosystems.
6. utilize classification schemes to order objects in biologically relevant contexts.	6. utilize correlational (e.g., population growth) and probabilistic (e.g., genetic sampling) thinking skills in simple contexts.	6. utilize correlational (e.g., prey and predator relationships) and probabilistic (e.g., genetic sampling) thinking skills in multiple contexts of increasing complexity.

Science Content Standard 4

Students demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space, and demonstrate thinking skills associated with this knowledge.

Rationale

By studying Earth, its composition, history and the processes that shape it, students gain a better understanding of the planet on which they live. Changes in lithosphere, atmosphere, and hydrosphere have profound effects on human existence. Knowledge of the Solar System and the universe helps students make predictions about Earth and informed decisions about the future of space exploration.

Benchmarks

Students will:

End of Grade 4	End of Grade 8	Upon Graduation—End of Grade 12
1. describe and give examples of earth's changing features.	1. model and explain the internal structure of the earth and describe the formation and composition of earth's external features in terms of the rock cycle and plate tectonics.	1. understand the theory of plate tectonics and how it explains the inter-relationship between earthquakes, volcanoes, and sea floor spreading.
2. describe the physical properties of earth's basic materials (including soil, rocks, water and gases).	2. differentiate between both rock types and mineral types and classify both by how they are formed and the utilization by humans. (e.g., arrowheads, cooking tools)	2. identify and classify rocks and minerals based on physical and chemical properties and the utilization by humans. (e.g., natural resources, building materials)
3. investigate fossils and make inferences about life and the environment long ago.	3. explain scientific theories about how fossils are used as evidence of changes over time.	3. use fossils and technology to describe the geological timeline.
4. observe and describe local weather and demonstrate how weather conditions are measured.	4. describe the water cycle, the composition and structure of the atmosphere and the impact of oceans on large scale weather patterns.	4. collect and analyze local, regional predictions about weather patterns, and global weather-related data by using appropriate technology in order to make inferences and predictions about weather patterns.
5. identify seasons and explain the difference between weather and climate.	5. describe and model the motion and tilt of earth in relation to the sun, and explain the concepts of day, night, seasons, year, and climatic changes.	5. explain the impact of terrestrial, solar, oceanic, and atmosphere conditions on global climatic patterns.
6. identify objects (e.g., moon, stars, meteors) in the sky and explain that light and heat comes from a star called the sun.	6. describe the earth, moon, planets and other objects in space in terms of size, structure, and movement in relation to the sun.	6. describe the origin, location, and evolution of stars and their planetary systems in respect to the solar system, the milky way, the local galactic group, and the universe.
7. identify technology and methods used for space exploration. (e.g., also use star parties, space shuttles, telescopes)	7. identify scientific theories about the origin and evolution of the earth and solar system.	7. relate how evidence from advanced technology, applied to scientific investigations (e.g., large telescopes and space-borne observatories), has dramatically impacted our understanding of the origin, size, and evolution of the universe.

Science Content Standard 5

Students understand how scientific knowledge and technological developments impact today's societies and cultures.

Rationale

Our world and human activity is shaped in many ways by the advances in science. Science and technology are reciprocal in that science drives technological advances and these advances drive future scientific endeavors. Many different cultures make contributions to science and technology. These advances affect different societies in different ways. It is vital that students understand the interrelationships of science, technology and human activity.

Benchmarks

Students will:

End of Grade 4	End of Grade 8	Upon Graduation—End of Grade 12
1. describe and discuss examples of how people use science and technology.	1. describe the specific fields of science and technology as they relate to occupations within those fields.	1. predict how key factors (e.g., technology, competitiveness, world events) affect the development and acceptance of scientific thought.
2. describe a scientific or technological innovation that impacts communities, cultures, and societies.	2. apply scientific knowledge and process skills to understand issues and everyday events.	2. give examples of scientific innovation challenging commonly held perceptions.
3. simulate scientific collaboration by sharing and communicating ideas to identify and describe problems.	3. simulate collaborative problem solving and give examples of how scientific knowledge and technology are shared with other scientists and the public.	3. evaluate the ongoing, collaborative scientific process by gathering and critiquing information from the popular media.
4. use scientific knowledge to make inferences and propose solutions for simple environmental problems. (e.g., recycling, waste management)	4. use scientific knowledge to investigate problems and their proposed solutions and evaluate those solutions while considering environmental impacts.	4. analyze benefits, limitations, costs, consequences, and ethics involved in using scientific and technological innovations. (e.g., biotechnology, environmental issues)

Science Content Standard 6

Students understand historical developments in science and technology.

Rationale

Students need to understand that scientific knowledge was influenced greatly by societal influences. They also need to know that scientific and technological advances have influenced society. For instance, the development of the atom bomb and the discovery that microbes cause disease both had a major impact on society. Therefore, the use of history in school science programs is necessary to clarify different aspects of scientific discovery, to understand that scientific knowledge is publicly shared and to understand the role that science has played in the development of various cultures.

Benchmarks:

Students will:

End of Grade 4	End of Grade 8	Upon Graduation—End of Grade 12
1. give historical examples of scientific and technological contributions to communities, cultures and societies.	1. trace development that demonstrate scientific knowledge is subject to change as new evidence becomes available.	1. give examples of scientific discoveries and describe the interrelationship between technological advances and scientific understanding.
2. describe how scientific inquiry has produced much knowledge about the world.	2. identify major milestones in science that have impacted science, technology, and society.	2. analyze and illustrate the historical impact of scientific and technological advances.
3. describe science as a human endeavor.	3. describe and explain science as a human endeavor.	3. describe, explain, and predict science as a human endeavor.

Science Performance Descriptors: A Profile of Four Levels

The Science Performance Descriptors define students' knowledge, skills, and abilities in the science content area on a continuum from kindergarten through grade 12. These descriptions provide a picture or profile of student achievement at four performance levels: advanced, proficient, nearing proficiency, and novice.

Advanced:	This level denotes superior performance.
Proficient:	This level denotes solid academic performance for each benchmark. Students reaching this level have demonstrated competency over challenging subject matter, including subject-matter knowledge, application of such knowledge to real-world situations, and analytical skills appropriate to the subject matter.
Nearing Proficiency:	This level denotes that the student has partial mastery of the prerequisite knowledge and skills fundamental for proficient work at each benchmark.
Novice:	This level denotes that the student is beginning to attain the prerequisite knowledge and skills that are fundamental for work at each benchmark.

Grade 4 Science

Advanced: (1) A fourth-grade student at the advanced level in science demonstrates superior performance. He/she:

(a) completes a simple investigation using appropriate tools and with identified variables, identifies relationships and communicates results;

(b) selects and uses tools for measurement of solids, liquids, and gases, identifying properties of each state of matter and describes and models characteristics of and changes within physical and mechanical systems;

(c) identifies multiple attributes of biotic (living) and abiotic (non-living) objects, including: classification based on similarities and differences; describes and models structures, functions, and processes of biotic (living) and abiotic (non-living) systems;

(d) describes and explains the details of Earth's physical features and cycles;

(e) discusses interactions among technology, science, and society;

(f) independently reads scientific information in the news and is able to discuss the possible impact on local problems;

(g) identifies the historical significance of scientists and discusses the impacts of their discoveries on humans today.

Proficient: (1) A fourth-grade student at the proficient level in science demonstrates solid academic performance. He/she:

(a) with direction, completes a simple investigation with identified variables, using appropriate tools and communicates results;

(b) selects and uses tools for simple measurement of solids, liquids, and gases, identifying properties of each state of matter and describes and models characteristics of and changes within basic physical and mechanical systems;

(c) identifies attributes of biotic (living) things and abiotic (non-living) objects, including: classification based on similarities and differences, basic structure and function, processes of each system;

(d) identifies and accurately illustrates Earth's features, locating several observable changes of those features;

(e) with direction, discusses interactions among technology, science, and society;

(f) discusses scientific information related to current events and local problems;

(g) identifies the historical significance of scientists and identifies the impacts of their discoveries on humans today.

Nearing Proficiency: (1) A fourth-grade student at the nearing proficiency level in science demonstrates partial mastery of the prerequisite knowledge and skills fundamental for proficiency in science. He/she:

(a) identifies and describes a simple investigation; with step by step direction, given the appropriate tools, identifies and describes a simple investigation;

(b) with direction, effectively uses tools for simple measurement of solids, liquids, and gases, naming some properties of each state of matter and names components of basic physical and mechanical systems;

(c) names some basic attributes of biotic (living) and abiotic (non-living) objects; groups objects based on common attributes; provides basic descriptions of structure, function, and processes of a system;

(d) names and describes Earth's features and recognizes simple, observable changes of those features;

(e) identifies interactions among technology, science and society;

(f) identifies how science plays a role in current events and local problems;

(g) identifies the historical significance of scientists, and with direction, identifies the impacts of their discoveries on humans today.

Novice: (1) A fourth-grade student at the novice level in science is beginning to attain the prerequisite knowledge and skills that are fundamental in science. He/she:

(a) identifies and describes a simple investigation with identified variables;

(b) has difficulty using tools for simple measurement of solids, liquids, and gases; has difficulty naming components of basic physical and mechanical systems;

(c) with direction, identifies basic attributes of biotic (living) and abiotic (non-living) objects; groups objects based on common attributes;

(d) with direction, names and describes Earth's features and identifies fundamental changes of those features;

(e) has difficulty identifying how scientific inquiry can blend current events and local issues;

(f) with direction, identifies how science plays a role in current events and local problems;

(g) identifies the historical significance of a prominent scientist and with direction, identifies the impact of his or her discoveries on humans today.

Grade 8 Science

Advanced: (1) An eighth-grade student at the advanced level in science demonstrates superior performance. He/she:

(a) generates testable questions, constructs a plan for a controlled investigation, makes logical inferences based on observations, accurately interprets data by identifying the strengths and weaknesses in an investigation design, and communicates results;

(b) uses physical, mental, theoretical, and mathematical models to investigate individually generated problems and/or questions about physical and chemical phenomena;

(c) organizes, classifies, and describes interactions of the biotic (living) and abiotic (non-living) parts of the biosphere as well as the natural history of interactions of life on Earth

and uses these skills to solve related novel (to the student) problems;

(d) describes, explains and models the processes that occur in the lithosphere, hydrosphere, and atmosphere of the Earth and the universe;

(e) analyzes and communicates connections and interactions among technology, science, and society by applying scientific inquiry;

(f) makes informed decisions about scientific and social issues based on observations, data, analysis, and knowledge of the natural world, and effectively communicates those decisions to others;

(g) independently identifies and describes examples of how science and technology are the results of human activity throughout history and independently seeks new information that connects past to present.

Proficient: (1) An eighth-grade student at the proficient level in science demonstrates solid academic performance. He/she:

(a) identifies and communicates testable questions, plans and conducts experimental investigations and communicates results;

(b) given supporting detail, describes the physical world through the application of simple chemical reactions, chemical formulas, physical, theoretical and mathematical models;

(c) identifies and classifies biotic (living) things and abiotic (non-living) objects through the application of common classification schemes; identifies the interdependence of life and the environment, and explains how characteristics of living things change because of the environment;

(d) describes and explains the structure and function of the Earth's lithosphere, hydrosphere, and atmosphere and the universe;

(e) describes connections and interactions among technology, science, and society by applying scientific inquiry;

(f) describes scientific information related to current events and the impact on local problems;

(g) independently identifies and describes examples of how science and technology are the results of human activity throughout history, and with direction, seeks new information that connects past to present.

Nearing Proficiency: (1) An eighth-grade student at the nearing proficiency level in science demonstrates partial mastery of the prerequisite knowledge and skills fundamental for proficiency in science. He/she:

(a) with step by step direction identifies, communicates testable questions, and plans a controlled investigation, making simple inferences based on observations and interpretation of data;

(b) gives explanations describing the physical world; through the use of simple chemical reactions, chemical formulas and physical laws, and physical models;

(c) describes interactions of the biotic (living) and abiotic (non-living) parts of the biosphere; uses common classification schemes, lists examples of the interdependence of life and the environment;

(d) describes the basic structure and function of the Earth's lithosphere, hydrosphere, and atmosphere and the universe;

(e) with direction, describes connections and interactions among technology, science, and society by applying scientific inquiry;

(f) expresses how current events impact local problems and with prompting, can discuss scientific information that effects these problems;

(g) with direction, identifies and describes examples of how science and technology are the results of human activity throughout history, and with direction, seeks new information that connects past to present.

Novice: (1) An eighth-grade student at the novice level in science is beginning to attain the prerequisite knowledge and skills that are fundamental in science. He/she:

(a) identifies and describes a testable question, a plan for a controlled investigation, and makes simple observations;

(b) with direction describes the physical world; identifies simple chemical reactions, chemical formulas, and demonstrates a limited understanding of physical models;

(c) with direction, describes some basic interactions of the biotic (living) and abiotic (non-living) parts of the biosphere; with direction provides basic descriptions of structure and function;

(d) with direction, identifies and describes the basic structure and function of the Earth's

lithosphere, hydrosphere, and atmosphere and the universe;

(e) with direction, identifies connections and interactions among technology, science, and society;

(f) with direct instruction, can discuss basic scientific information in current events and how it impacts local problems;

(g) with direction, identifies and describes examples of how science and technology are the results of human activity throughout history.

Upon Graduation Science

Advanced: (1) A graduating student at the advanced level in science demonstrates superior performance. He/she:

(a) formulates testable questions, constructs a plan, makes logical inferences, interprets data by identifying the strengths and weaknesses, and communicates results; presents another investigation that more accurately assesses the topic of study;

(b) creates and uses physical, mental, theoretical, and mathematical models to investigate individually generated problems and/or questions about physical and chemical phenomena;

(c) creates and uses physical, mental, theoretical, and mathematical models to investigate individually generated problems and/or questions about the biotic (living) and abiotic (non-living) parts of the biosphere as well as the natural history of interactions of life on Earth and uses these skills to solve related novel (to the student) problems;

(d) creates and uses physical, mental, theoretical, and mathematical models to investigate individually generated problems and/or questions about the processes that occur in the lithosphere, hydrosphere, and atmosphere of the Earth and the universe;

(e) analyzes and evaluates connections and interactions among technology, science, and society by applying scientific inquiry;.

(f) discriminately compares scientific and social issues based on observations, data, analysis, and knowledge of the natural world, and effectively communicates those decisions to others;

(g) identifies the positive and negative impacts of past, present, and future technological and scientific advances, and gives possible solutions that may minimize the negative impacts on the global community.

Proficient: (1) A graduating student at the proficient level in science demonstrates solid academic performance. He/she:

(a) generates testable questions, constructs a plan for a controlled investigation, makes logical inferences based on observations, accurately interprets data by identifying the strengths and weaknesses in an investigation design, and communicates results;

(b) uses physical, mental, theoretical, and mathematical models to investigate individually generated problems and/or questions about physical and chemical phenomena;

(c) organizes, classifies, and describes interactions of the biotic (living) and abiotic (non-living) parts of the biosphere as well as the natural history of interactions of life on Earth and uses these skills to solve related novel (to the student) problems;

(d) describes, explains and models the processes that occur in the lithosphere, hydrosphere, and atmosphere of the Earth and the universe;

(e) analyzes and communicates connections and interactions among technology, science, and society by applying scientific inquiry;.

(f) makes informed decisions about scientific and social issues based on observations, data, analysis, and knowledge of the natural world, and effectively communicates those decisions to others;

(g) identifies the positive and negative impacts of past, present, and future technological and scientific advances, and with direction, gives possible solutions that may minimize the negative impacts on the global community.

Nearing Proficiency: (1) A graduating student at the nearing proficiency level in science demonstrates partial mastery of the prerequisite knowledge and skills fundamental for proficiency in science. He/she:

(a) with step by step direction conducts and communicates the results from simple investigations, sometimes inferring real world applications;

(b) identifies and constructs physical, mental, and mathematical models depicting the properties of matter in the physical world to investigate teacher-guided problems and/or questions about scientific phenomena;

(c) uses models to investigate problems and/or questions about the biotic (living) and abiotic (non-living) parts of the biosphere as well as the natural history of the interactions of life on Earth;

(d) with direction, describes, explains, and models the processes that occur in the lithosphere, hydrosphere, and atmosphere of the Earth and the universe;

(e) identifies and describes connections and interactions among technology, science, and society by applying scientific inquiry;.

(f) using scientific inquiry, partially communicates interactions of science, technology, and society;

(g) identifies the positive and negative impacts of past, present, and future technological and scientific advances.

Novice: (1) A graduating student at the novice level in science is beginning to attain the prerequisite knowledge and skills that are fundamental in science. He/she:

(a) identifies, describes and conducts a simple investigation; identifies a variable and makes real world applications;

(b) with direction, identifies and uses models depicting the properties of matter in the physical world;

(c) with direction, uses physical models to investigate problems and/or questions about the biotic (living) and abiotic (non-living) parts of the biosphere; describes some factors which may cause the extinction of a species;

(d) with direction, describes and explains processes that occur in the lithosphere, hydrosphere, and atmosphere of the Earth and the universe;

(e) identifies connections and interactions among technology, science, and society by applying scientific inquiry;.

(f) identifies, but inconsistently communicates interactions of science, technology, and their effect on society;

(g) with direction, identifies the positive and negative impacts of past, present, and future technological and scientific advances.